

Health Consultation

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY TOPOCK GROUNDWATER STUDY

Evaluation of Chromium in Groundwater Wells

GOLDEN SHORES AND TOPOCK
MOHAVE COUNTY, ARIZONA

SEPTEMBER 7, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
TOPOCK GROUNDWATER STUDY

Evaluation of Chromium in Groundwater Wells

GOLDEN SHORES AND TOPOCK
MOHAVE COUNTY, ARIZONA

Prepared by:

Arizona Department of Health Services
Office of Environmental Health
Environmental Health Consultation Services
Under a cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Purpose

From May 2005 to June 2005, the Arizona Department of Environmental Quality (ADEQ) conducted a study, Potable Well Sampling Task 4.0, to determine if the chromium and chromium VI plume due to the discharge of the Pacific Gas and Electric (PG&E) Topock Compressor Station has migrated under the Colorado River and impacted water supplies in Arizona. The ADEQ investigated the total chromium and hexavalent chromium (chromium VI) concentrations in (1) public water supply wells, (2) combined industrial and domestic water supply wells, and (3) private domestic water supply wells at Topock and Golden Shores, Arizona. The communities of Topock and Golden Shores have expressed their concerns regarding the findings. Thus, the ADEQ requested the Arizona Department of Health Services to evaluate the potential health effects of exposure to well water contaminated with chromium.

Background and Statement of Issues

The Pacific Gas and Electric Company (PG&E) Topock Compressor Station, located southeast of Needles, San Bernardino County, California, is a natural gas compressor station for transmission of natural gas by pipeline. From 1951 to 1985, PG&E used chromium VI as an anti-corrosion agent in the cooling towers to prevent corrosion of the cooling tower equipment. From 1951 to 1964, PG&E discharged about 6 million gallons per year of untreated wastewater containing chromium VI to Bat Cave Wash (CA, USA), which is normally a dry streambed that feeds into the Colorado River. Beginning in 1964, PG&E treated the wastewater to remove chromium VI. The treated wastewater was discharged into Bat Cave Wash until 1968, and subsequently into an on-site injection well between the years of 1970 to 1973. Over time, PG&E installed a series of lined evaporation ponds for wastewater disposal. In 1985, PG&E stopped using the chromium-based additive and switched to a phosphate-based solution. In 1996, PG&E entered into a Corrective Action Consent Agreement with the California Environmental Protection Agency, Department of Toxic Substances Control to investigate and clean up the chromium VI contamination at the Station (CalEPA 2004).

A plume of chromium VI has been identified in the groundwater at the compressor station, which is located 15 miles southeast of Needles, California. The plume has been detected in recently installed wells that are located less than 60 feet west of the Colorado River. To date, 70 monitoring wells, 4 extraction wells, and 2 injection wells have been installed at the site in California. Ground water extraction began in March 2004 as part of interim measures to contain the plume and protect the Colorado River. PG&E proposes to treat extracted groundwater and re-inject the treated water back into groundwater.

In February 2005, chromium VI was detected at a concentration of 354 parts per billion (ppb) in a newly installed well (Well MW-34-100) located 60 feet west of the Colorado River (CA, USA). Concentrations have since increased to 417 ppb. The Arizona Department of Environmental Quality (ADEQ) has expressed great concern about potential impacts of chromium VI on Arizona groundwater resources and Colorado River water uses since data from this well suggests that the eastern edge of the plume is undefined.

Discussion

Groundwater Sampling Data

From May 2005 to June 2005, GeoTrans Inc. (Phoenix, AZ) collected groundwater samples from the selected domestic, industrial and public water supply wells in the communities of Topock (one-half mile east-northeast across the Colorado River) and Golden Shores (eight miles north of the PG&E Topock Compressor Station), Arizona. Figure 1 shows the locations of the twenty wells sampled during the ADEQ Potable Well Sampling event.

Groundwater samples were analyzed for chromium VI and total chromium by EMAX Laboratories, Inc. (Torrance, CA) and TransWest GeoChem, Inc. (Phoenix, AZ), respectively. Chromium VI concentrations in groundwater samples were determined by EPA Method 218.6 and EPA SW (Test Methods for Evaluating Solid Waste, Physical/Chemical Methods) 7196A and total chromium concentrations in groundwater samples were determined by EPA Method 200.7. The measured concentrations of chromium VI in groundwater samples ranged from 0.61 to 26.2 micrograms per liter ($\mu\text{g/L}$). The measured concentrations of total chromium in groundwater samples ranged from < 10 (laboratory reporting limit) to $28 \mu\text{g/L}$. Table 1 and Figure 1 summarize the chromium analytical results for wells sampled during the May 2005 ADEQ Potable Well Sampling event.

The laboratory-reporting limit is the lowest reported concentration after corrections have been made for sample dilution and sample weight. The laboratory reporting limits ranged from 0.2 to $4 \mu\text{g/L}$ for EPA Method 218.6. The laboratory-reporting limit for both EPA Method SW 7196A and EPA Method 200.7 is $10 \mu\text{g/L}$. All the method blanks, laboratory spikes, filed and laboratory duplicates met quality control objectives, which indicates the analytical concentrations of chromium VI and total chromium detected by the laboratories are of high quality and high certainty.

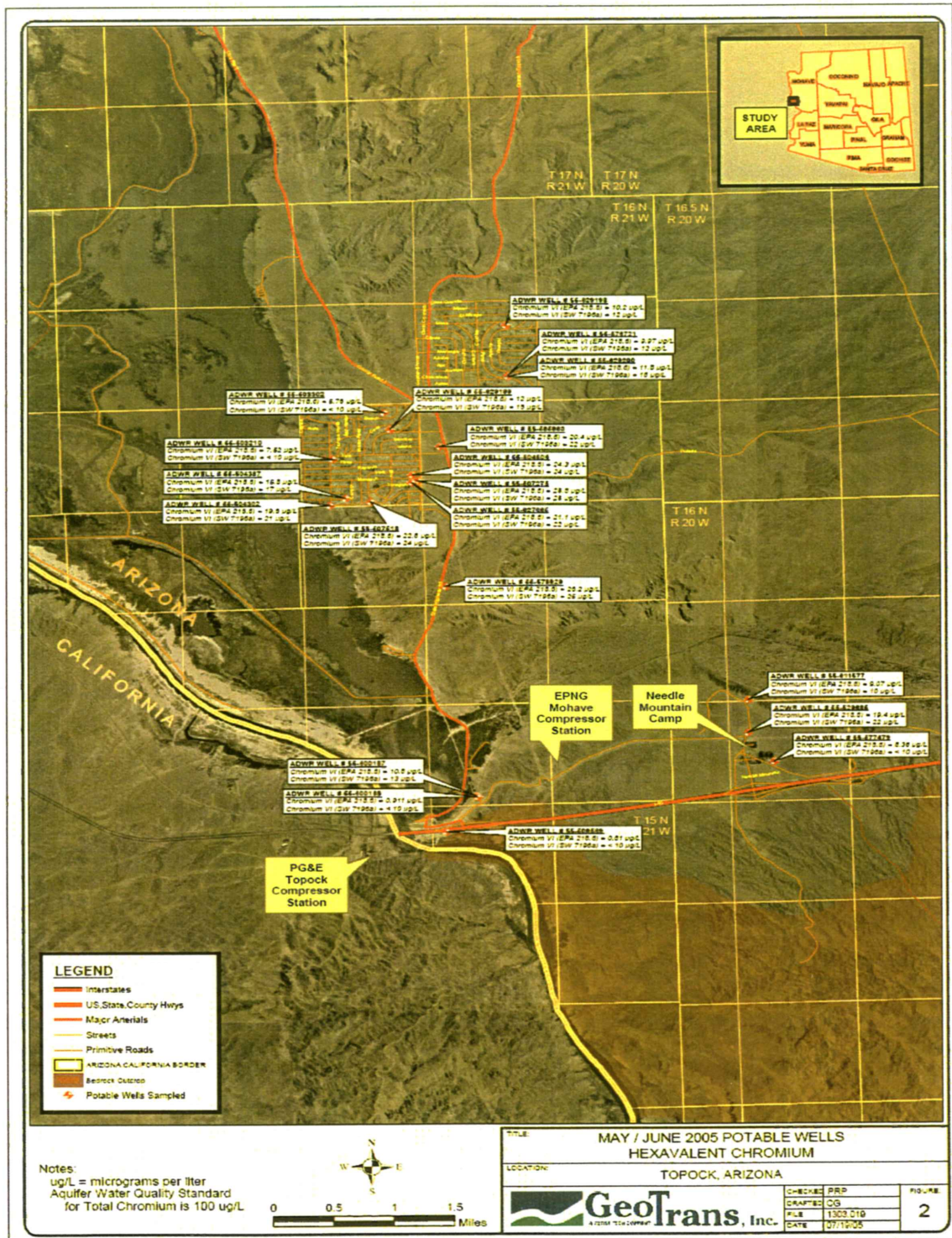


Figure 1. Arizona Department of Environmental Quality (ADEQ) Topock Groundwater Study Area

Figure 1¹ shows the wells that were selected for the 2005 potable well sampling as part of the ADEQ Topock groundwater study. $\mu\text{g/L}$: micrograms per liter; Arizona Aquifer Water Quality Standard for total chromium is 100 $\mu\text{g/L}$.

¹ This figure was prepared by GeoTrans Inc on behalf of the Arizona Department of Environmental Quality (ADEQ).

Table 1. Analytical results of chromium VI, total chromium and their duplicates in micrograms per liter (µg/L) for wells sampled during the May 2005 ADEQ Potable Well Sampling event

Well name	Well use	Measured concentration of chromium VI				Measured concentration of total chromium	
		EPA Method 218.6		EPA SW 7196A		EPA Method 200.7	
		Field sample	Duplicate	Field sample	Duplicate	Field sample	Duplicate
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Private well #1	Domestic	0.61		< 10 ^a		< 10	
Private well #2	Domestic	25.8		25		28	
Private well #3	Domestic	24.3		24		27	
Private well #4	Domestic	21.1		22		25	
Private well #5	Domestic	5.76		< 10	< 10 ^b	< 10	
Private well #6	Domestic	22.8		24		24	
Private well #7	Domestic	19.6	19.2 ^c	21	17	19	20
Private well #8	Domestic	15.8		17		16	
Private well #9	Domestic	7.52	7.57	< 10	< 10	< 10	
Private well #10	Domestic, irrigation	26.2	26	25	33	26	25
EPNG Topock 1	Domestic, industrial	19.4		22		23	
EPNG Topock 2	Domestic, industrial	9.07		10	11	11	
GSWC 1	Municipal	12.0		18		13	
GSWC 2	Municipal	10.2		12		< 10	
GSWC 3	Municipal	11.8		18		14	
GSWC 4	Municipal	9.97	10	12		12	
ADOT 2 new well	Domestic, industrial	8.36	8.3	< 10		10	
Topock School	Irrigation	20.4		22		21	
CON Topock 2	Domestic, industrial, municipal	0.91	0.90	< 10	< 10	11	
CON Topock 3	Domestic, industrial, municipal	10.8		13		15	

^a < 10 µg/L: laboratory-reporting limit

^b Green text represents laboratory duplicate sample results for quality control

^c Red text represents blind duplicate sample result for quality control

is an essential nutrient. Chromium VI and metal chromium are generally produced by industrial processes (ATSDR 2000).

The body absorbs chromium VI more readily than it absorbs chromium III. However, once absorbed by the body, chromium VI is rapidly changed to chromium III. The effects of chromium exposure on the human body vary according to the exposure route (i.e., inhalation, ingestion, or skin contact) and form of chromium. Inhalation exposure to chromium VI can result in marked damage to the nasal mucosa, perforation of the nasal septum and damage to the lower respiratory tract. However, breathing in chromium III does not cause irritation to the nose or mouth in most people (ATSDR 2000). The United States Environmental Protection Agency (U.S. EPA) has classified chromium VI as a known human carcinogen through inhalation. Chromium VI is not classified as a human carcinogen through ingestion or by dermal contact (U.S. EPA 2005a). Chromium III is not classified as a human carcinogen through inhalation, ingestion or dermal contact (U.S. EPA 2005b).

The Arizona Department of Health Services assesses a site by evaluating the level of exposure in potential or completed pathways to determine if residents are being exposed to chromium at levels of public health concern. An exposure pathway defines how a chemical may enter a person's body that may cause adverse health effects. The evaluation includes use of comparison values, which are screening tools used with environmental data relevant to the exposure pathways. Comparison values are concentrations of chemicals that can reasonably and conservatively be regarded as harmless to public health based on the available scientific data.

If public exposure concentrations related to a site are below the appropriate comparison value, then the exposures are not of public health concern and no further analysis of the pathway is conducted. However, while concentrations below the comparison value are not expected to lead to any observable adverse health effect, it should not be inferred that a concentration greater than the comparison value will necessarily lead to adverse health effects. Depending on site-specific environmental exposure factors (e.g., duration and amount of exposure) and individual human factors (e.g., personal habits, occupation, and/or overall health), exposure to levels above the comparison value may or may not lead to a health effect. Therefore, the comparison values should not be used to predict the occurrence of adverse health effects.

The Arizona Department of Health Services used average concentrations of chromium VI to evaluate the potential health effects because they are most representative of the concentration that would be contacted at a site. If the detected chromium concentration is indicated as non-detect (i.e., $< 10 \mu\text{g/L}$) in the laboratory report, the concentration of chromium VI was assumed to be $10 \mu\text{g/L}$. This assumption is the most conservative for risk assessment, because it will tend to bias data on the high side. This approach indicates that there is a high degree of confidence that chromium is present, but at a level that is at or just below the laboratory-reporting limit.

In addition, the average concentrations of chromium VI were determined based on the analytical results of both EPA Method 218.6 and EPA Method SW 7196A. For example, for Private Well # 10, averaging the EPA Method 218.6 and EPA Method SW 7196A values in Table 1 (i.e., 26.2 and $25 \mu\text{g/L}$) results in an average concentration of 25.6

Table 2. Measured chromium VI concentrations in micrograms per liter (µg/L) compared to ATSDR's Reference Dose Media Evaluation Guide (RMEG).

Well name	Sampling date	Well use	Average concentration of chromium VI	Does the detected concentration value exceed the ATSDR RMEG for chromium VI?	
				Child 30 µg/L	Adult 100 µg/L
Private well #1	05/24/05	Domestic	5.3	No	No
Private well #2	05/26/05	Domestic	25.4	No	No
Private well #3	05/26/05	Domestic	24.2	No	No
Private well #4	05/26/05	Domestic	21.6	No	No
Private well #5	05/26/05	Domestic	7.9	No	No
Private well #6	05/31/05	Domestic	23.4	No	No
Private well #7	06/01/05	Domestic	20.3	No	No
Private well #8	06/01/05	Domestic	16.4	No	No
Private well #9	06/01/05	Domestic	8.8	No	No
Private well #10	05/31/05	Domestic, irrigation	25.6	No	No
EPNG Topock 1	05/25/05	Domestic, industrial	20.7	No	No
EPNG Topock 2	05/25/05	Domestic, industrial	9.5	No	No
GSWC 1	06/02/05	Municipal	15.0	No	No
GSWC 2	06/02/05	Municipal	11.1	No	No
GSWC 3	06/02/05	Municipal	14.9	No	No
GSWC 4	06/02/05	Municipal	11.0	No	No
ADOT 2 (new well)	05/25/05	Domestic, industrial	9.2	No	No
Topock School	06/01/05	Irrigation	21.2	No	No
CON Topock 2	05/24/05	Domestic, industrial, municipal	5.5	No	No
CON Topock 3	05/24/05	Domestic, industrial, municipal	11.9	No	No

Table 3. Measured total chromium concentrations in micrograms per liter (µg/L) compared to Arizona Aquifer Water Quality Standard (AAWQS) and the U.S. EPA Maximum Contamination Level (MCL) for total chromium.

Well name	Well use	Detected concentration of total chromium		Does the detected concentration value exceed AAWQS for total chromium?	Does the detected concentration value exceed the U.S. EPA MCL for total chromium?
Standard		µg/L		100 µg/L	100 µg/L
Sampling year		1996	2005		
Private well #1	Domestic	NS ^a	< 10	No	No
Private well #2	Domestic	24	28	No	No
Private well #3	Domestic	NS	27	No	No
Private well #4	Domestic	NS	25	No	No
Private well #5	Domestic	NS	< 10	No	No
Private well #6	Domestic	20	24	No	No
Private well #7	Domestic	15	19	No	No
Private well #8	Domestic	NS	16	No	No
Private well #9	Domestic	ND ^b	< 10	No	No
Private well #10	Domestic, irrigation	NS	26	No	No
EPNG Topock 1	Domestic, industrial	NS	23	No	No
EPNG Topock 2	Domestic, industrial	NS	11	No	No
GSWC 1	Municipal	ND	13	No	No
GSWC 2	Municipal	12	< 10	No	No
GSWC 3	Municipal	NS	14	No	No
GSWC 4	Municipal	NS	12	No	No
ADOT 2 (new well)	Domestic, industrial	NS	10	No	No
Topock School	Irrigation	NS	21	No	No
CON Topock 2	Domestic, industrial, municipal	NS	11	No	No
CON Topock 3	Domestic, industrial, municipal	NS	15	No	No

^a NS: not sampled

^b ND: not detected; laboratory reporting limit: < 10 µg/L

ATSDR Child Health Initiative

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contaminants in environmental media. Children's developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages. Children ingest a larger amount of water relative to body weight, resulting in higher burden of pollutants. Furthermore, children often engage in vigorous outdoor activities, making them more sensitive to pollution than healthy adults. All health analyses in this report take into consideration the unique vulnerability of children. Children will not be adversely affected by the levels of chromium found in groundwater wells at Topock and Golden Shores, AZ.

Conclusions

The Arizona Department of Health Services has classified the study sites as "No Apparent Public Health Hazard." This classification is based upon the following conclusions:

- Low levels of total chromium and chromium VI are present in the groundwater wells.
- Exposures to total chromium and chromium VI are not at levels that are likely to cause adverse health effects, even to children and sensitive populations.
- The sites do not pose a public health hazard because exposure concentrations are low.

If further information becomes available, the Arizona Department of Health Services will evaluate it and update conclusions as necessary.

Recommendations

The Arizona Department of Health Services does not have any recommendation at this time.

Public Health Action Plan

The Arizona Department of Health Services staff will attend community meetings to communicate the results of this consultation. The Arizona Department of Health Services will gather community concerns and answer any additional questions that community members have.

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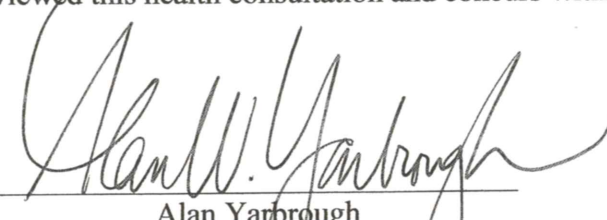
Certification

The Arizona Department of Environmental Quality Topock Groundwater Study Health Consultation was prepared by the Arizona Department of Health Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.



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The Division of Health Assessment and Consultation, Agency for Toxic Substance and Disease Registry, has reviewed this health consultation and concurs with its findings.



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